Pune Vidyarthi Griha College of Engineering
and Technology Pune

DIGITAL SIGNAL PROCESSING

Application Assignment

Image Steganography Using DWT

Hybrid Group No: 5

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Group Member 3: Sonal Datere

Guided By: **Dr Vikram Gadre Sir**

1. Title
2. Software/Platform used
3. Steps to install and run the code
4. Stepwise windows screenshots
5. Block Diagram
6. Algorithm used
7. Observation
8. Conclusion
9. Code Links

1.Title

Image Steganography Using DWT

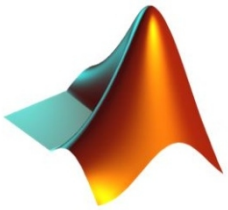
2.Software/Platform used

Coding: MATLAB [R2021A]

Toolbox: Image toolbox,DSP toolbox

3.Steps to Download, install & run the code

MATLAB SIMULINK



MathWorks introduced Release 2021a of the MATLAB and Simulink product families. Release 2021a (R2021a) offers hundreds of new and updated features and functions in MATLAB® and Simulink®, along with three new products and 12 major updates. New capabilities in MATLAB include dynamic controls in live scripts as well as a new task for adding plots to live scripts without writing any code. Simulink updates enable users to import C code as reusable Simulink libraries and to speed up simulations. R2021a also introduces new products in the areas of satellite communications, radar, and DDS applications.

About MathWorks

MathWorks is the leading developer of mathematical computing software. MATLAB, the language of engineers and scientists, is a programming environment for algorithm development, data analysis, visualization, and numeric computation. Simulink is a block diagram environment for simulation and Model-Based Design of multidomain and embedded engineering systems. Engineers and scientists worldwide rely on these product families to accelerate the pace of discovery, innovation, and development in automotive, aerospace, electronics, financial services, biotech-pharmaceutical, and other industries. MATLAB and Simulink are also fundamental teaching and research tools in the world's universities and learning institutions. Founded in 1984, MathWorks employs more than 5000 people in 16

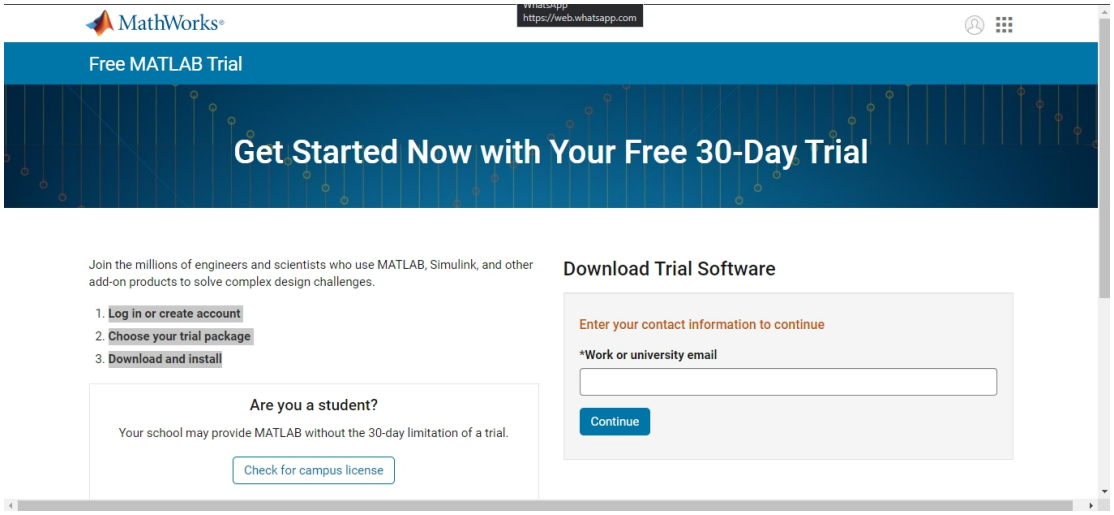
countries, with headquarters in Natick, Massachusetts, USA. For additional information, visit mathworks.com.

1. **Log in or create account**
2. **Choose your trial package**
3. **Download and install**

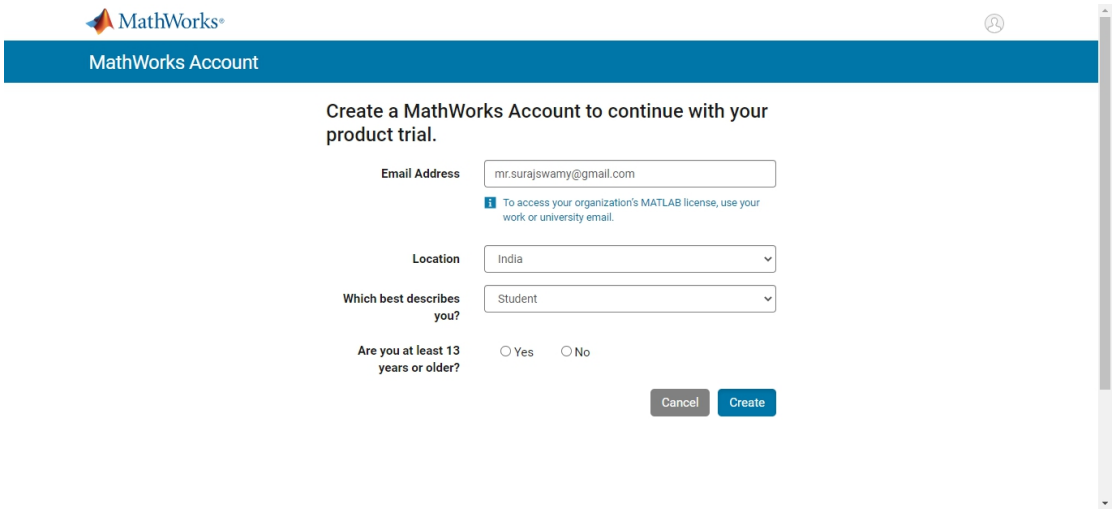
For downloading MAtlab one should have an email acoount registered with the matlab.

Link for rgistretion to download trial software for 30 days trial:

https://in.mathworks.com/mwaccount/register?form_type=trial&&uri=https%3A%2F%2Fin.mathworks.com%2Fcampaigns%2Fproducts%2Ftrials.html%3Fprodcode%3DML

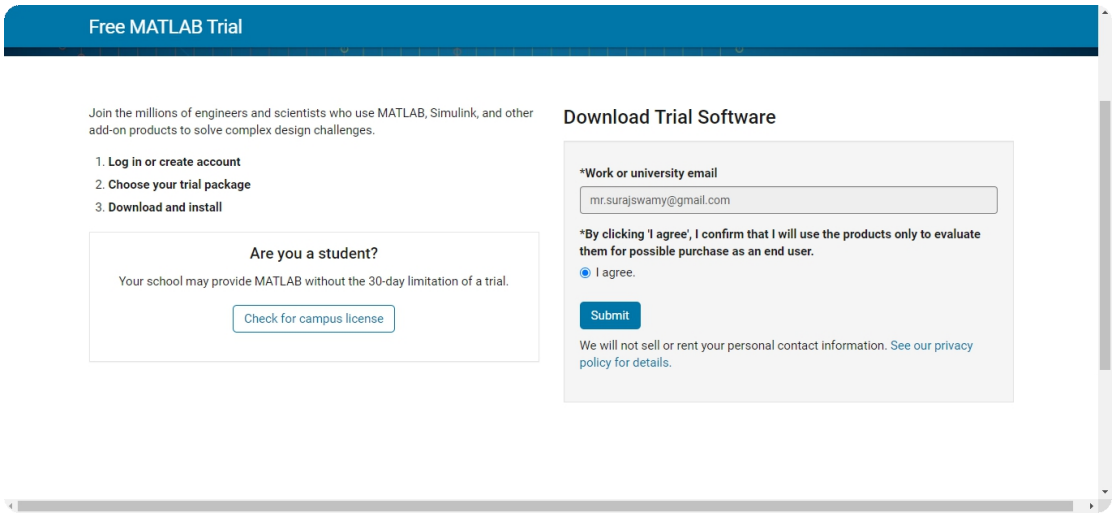


Fill all important information

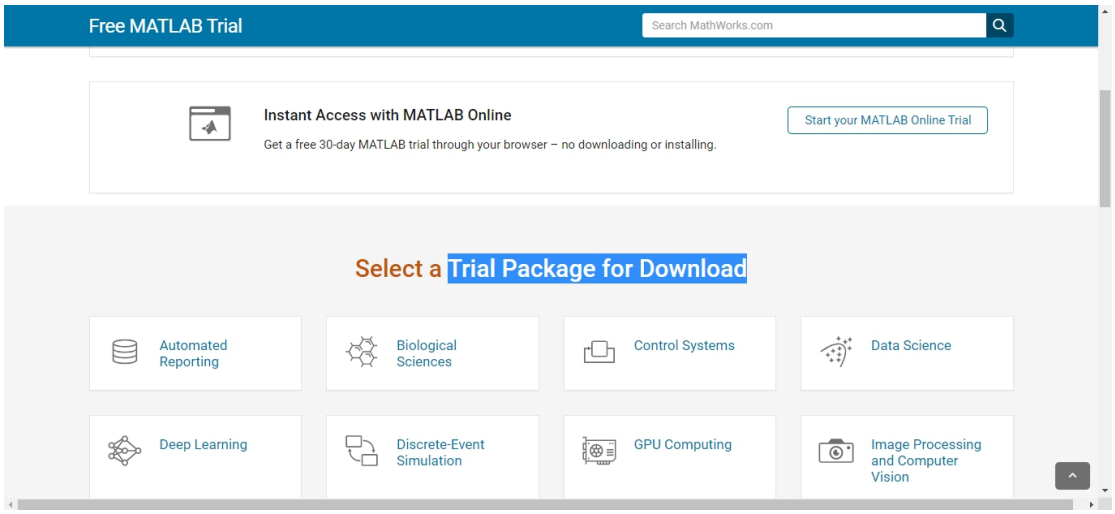


After creating an account , you will get the conformation link and then log in into your account.

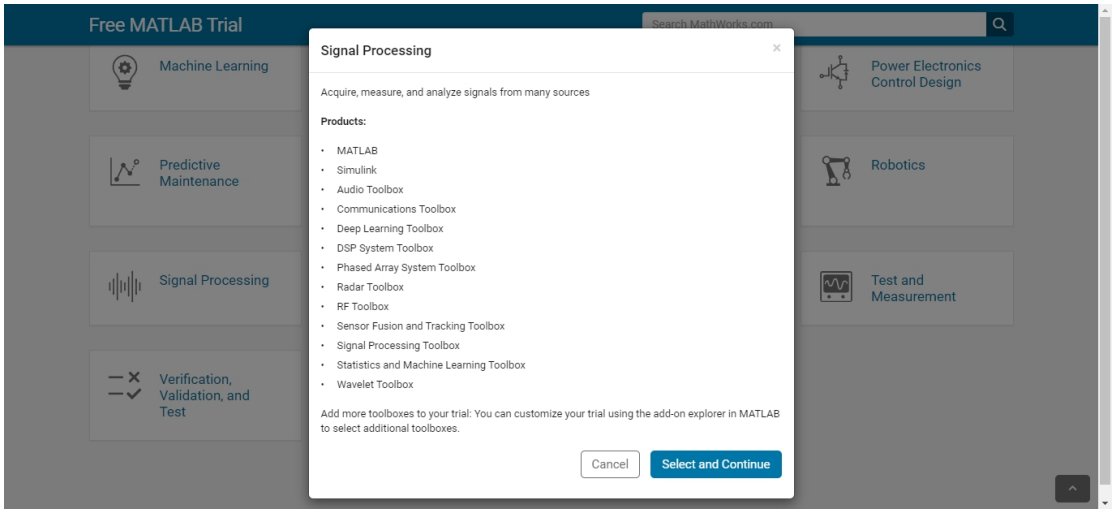
After that click on ‘I agree’ and submit



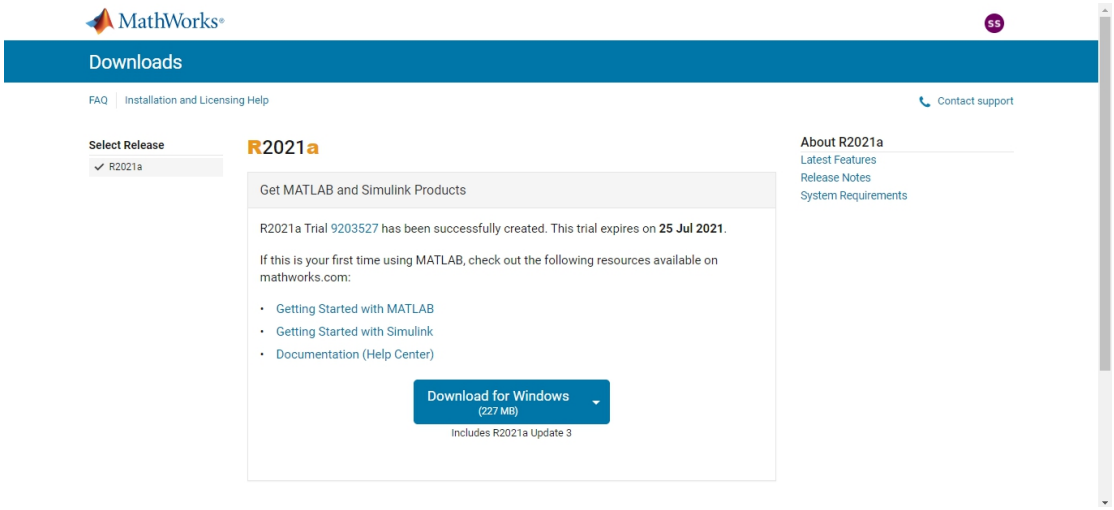
After that you will get the window for ‘Trial Package for Download’



Scroll down and select the ‘signal processing ‘ packege as per our project requirement & you will get the screen as like

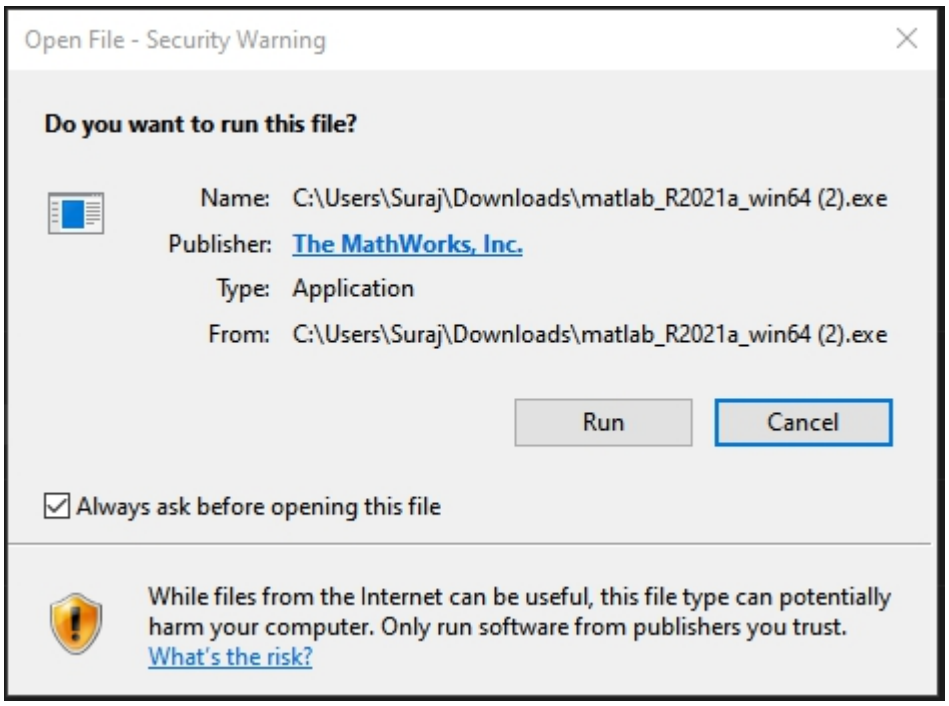


Click on ‘select and continue’



Click on ‘Download for Windows’ , the 227MB file will be downlod as per our OPERATING SYSTEM.

Once the file get downloaded select to open and run

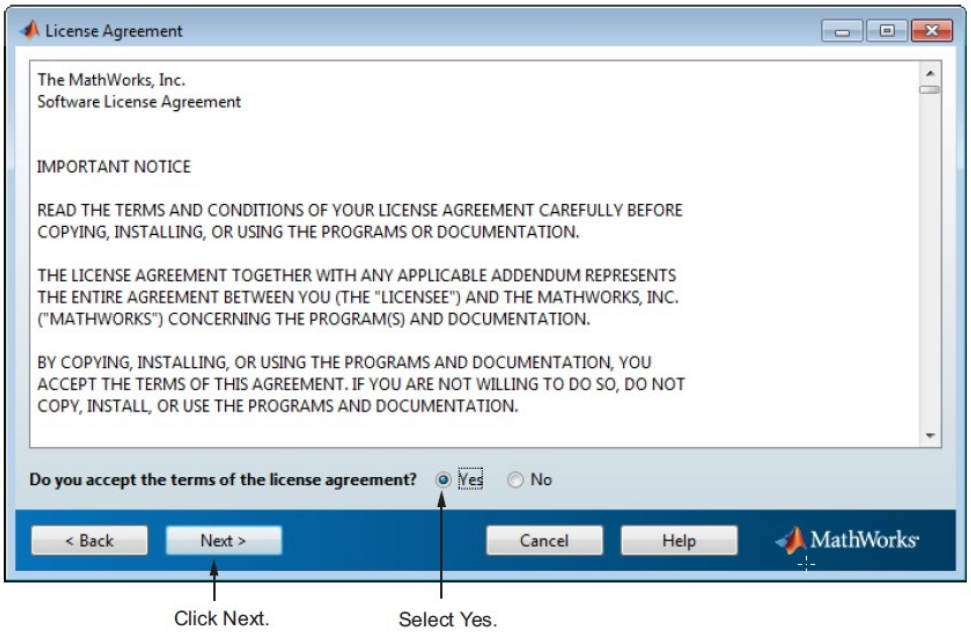


After this INSTALLATION process starts

The installer displays the following dialog box. Select the Install without using the Internet option and Click OK to proceed with installation.

Review the License Agreement

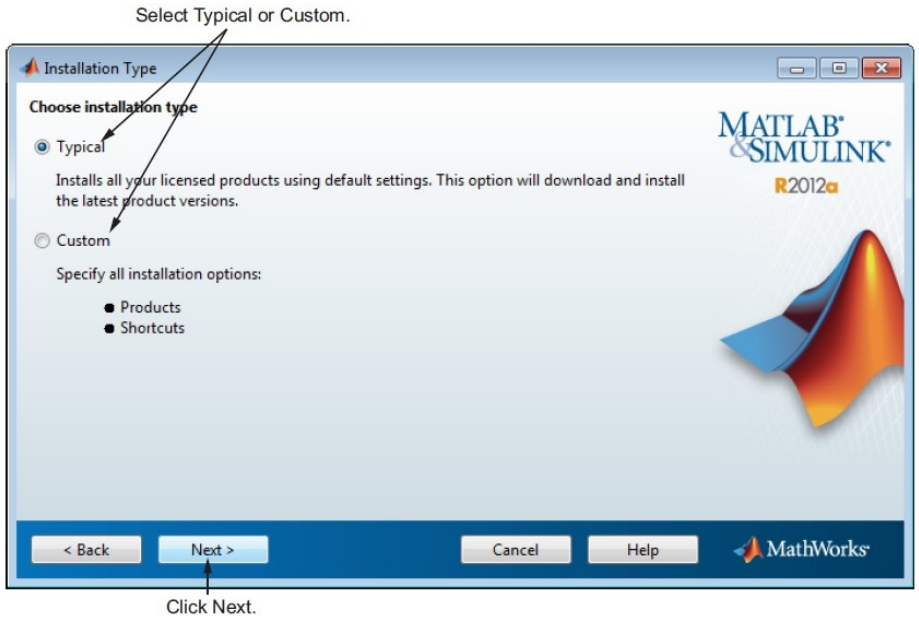
Review the software licensing agreement and, if you agree to its terms, click Yes.



Enter your File Installation Key and click ok.

Choose the Installation Type

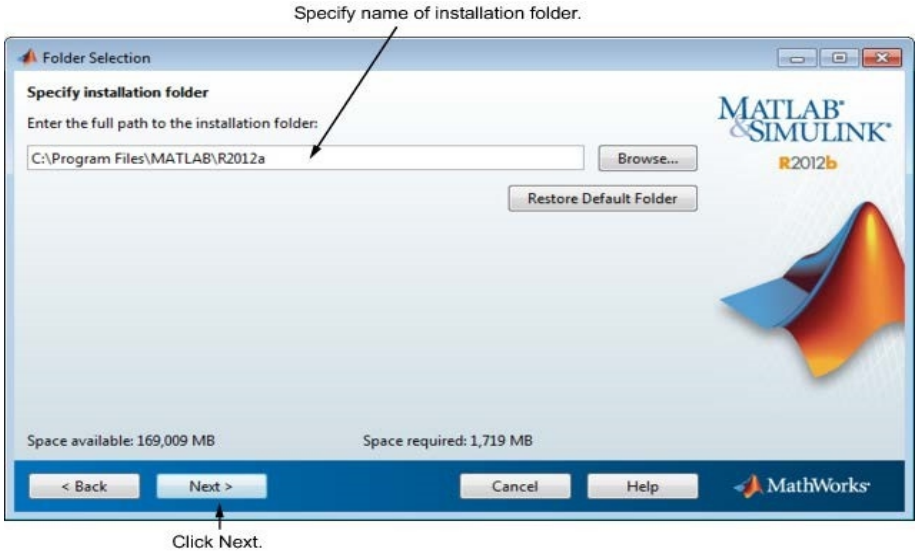
In the Installation Type dialog box, specify whether you want to perform a Custom installation and click Next.



Specify the Installation Folder

Specify the name of the folder where you want to install MathWorks products.

Accept the default installation folder or click Browse to select a different one. If the folder doesn't exist, the installer creates it.

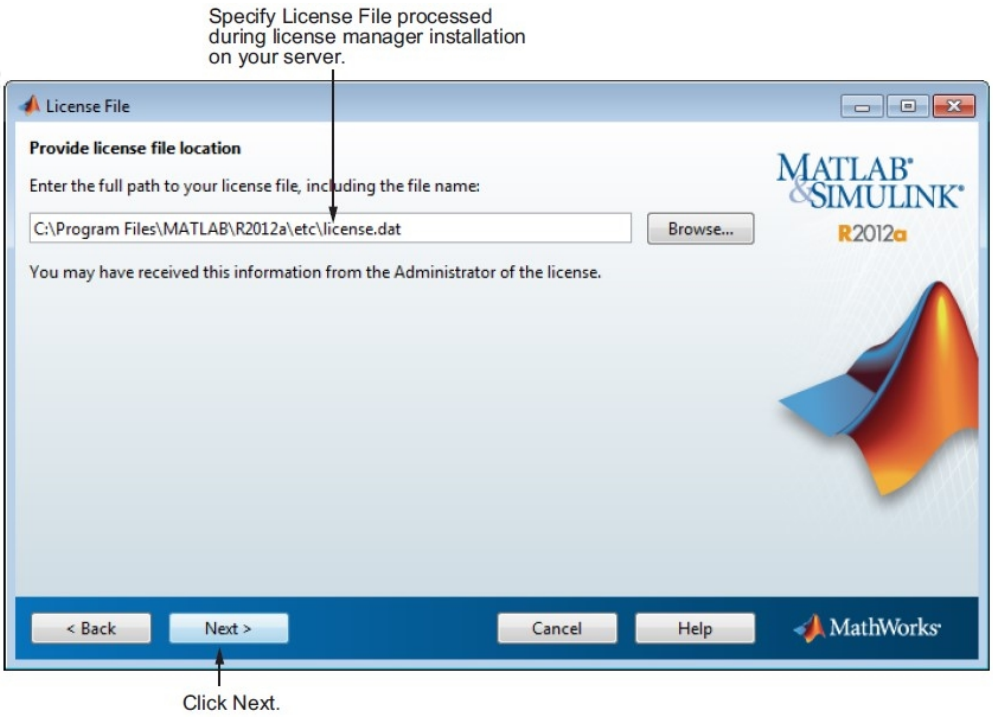


Specify Products to Install (Custom Only)

Leave it by default and continue. After that,

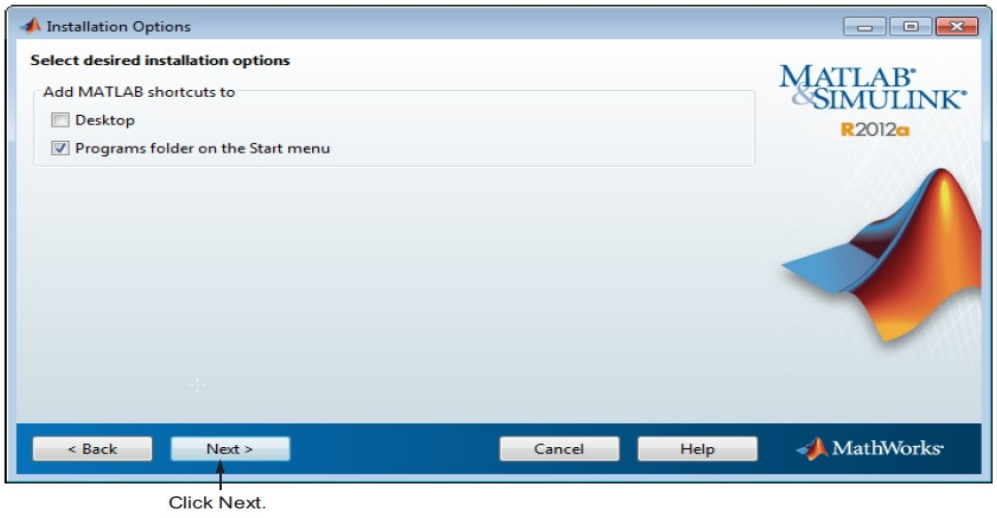
Specify the Location of the License File

Enter the full path of your License File in the text box (or drag and drop the file) and click Next.



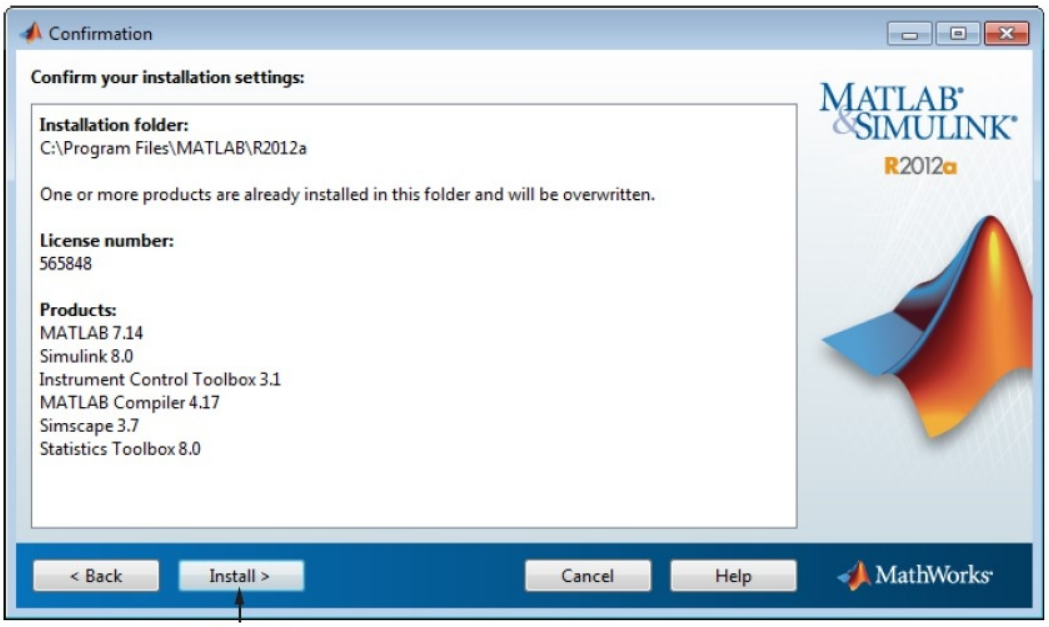
Specify Installation Options (Custom Only)

After selecting installation options, click Next to proceed with the installation.



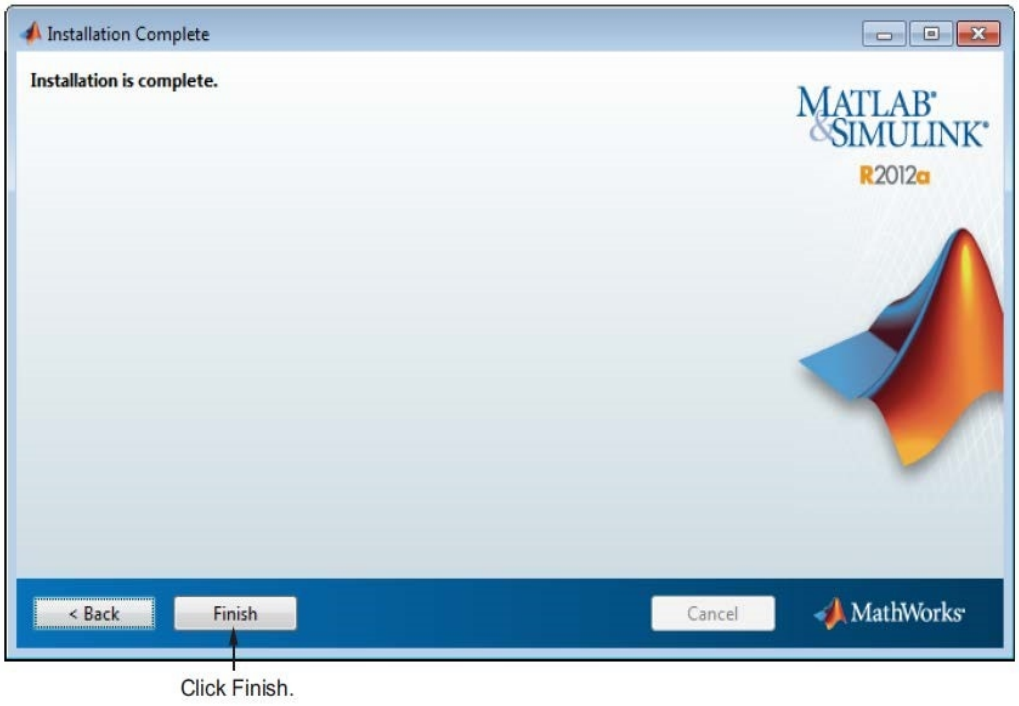
Confirm Your Choices and Begin Copying Files

Before it begins copying files to your hard disk, the installer displays a summary of your installation choices. To change a setting, click Back. To proceed with the installation, click Install.



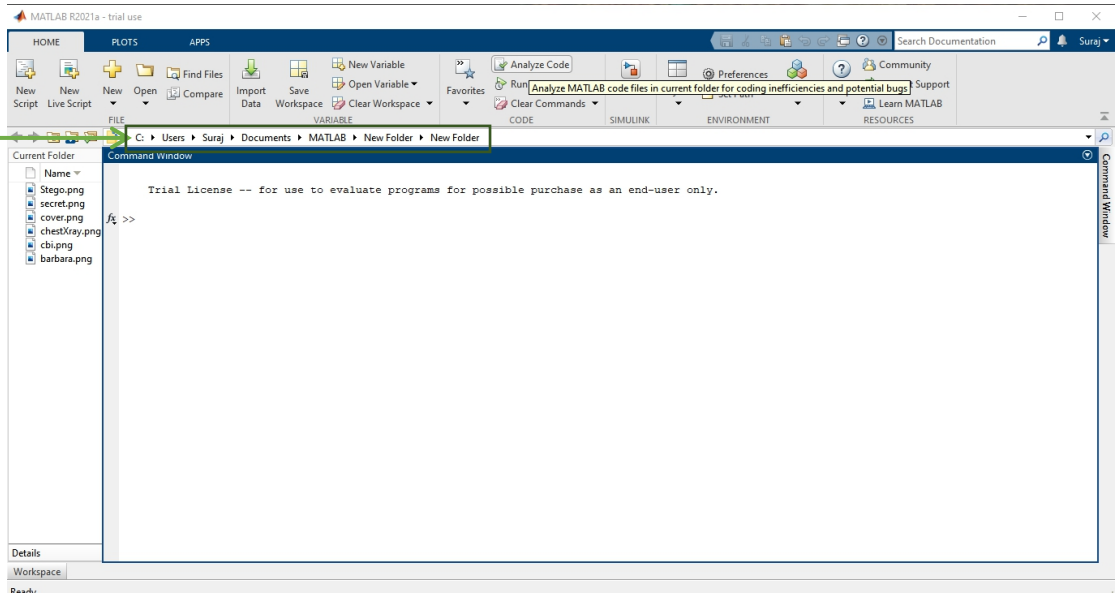
As it copies files to your hard drive, the installer displays a status dialog box to show the progress of the installation.

Complete the Installation

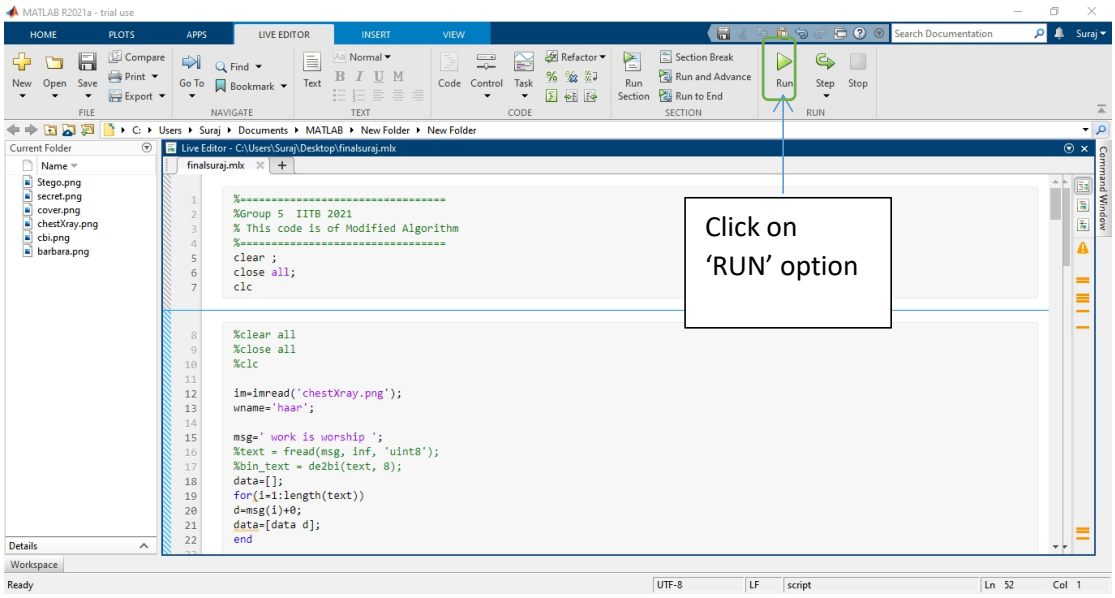


Now we are ready to open the MATLAB on out desktop

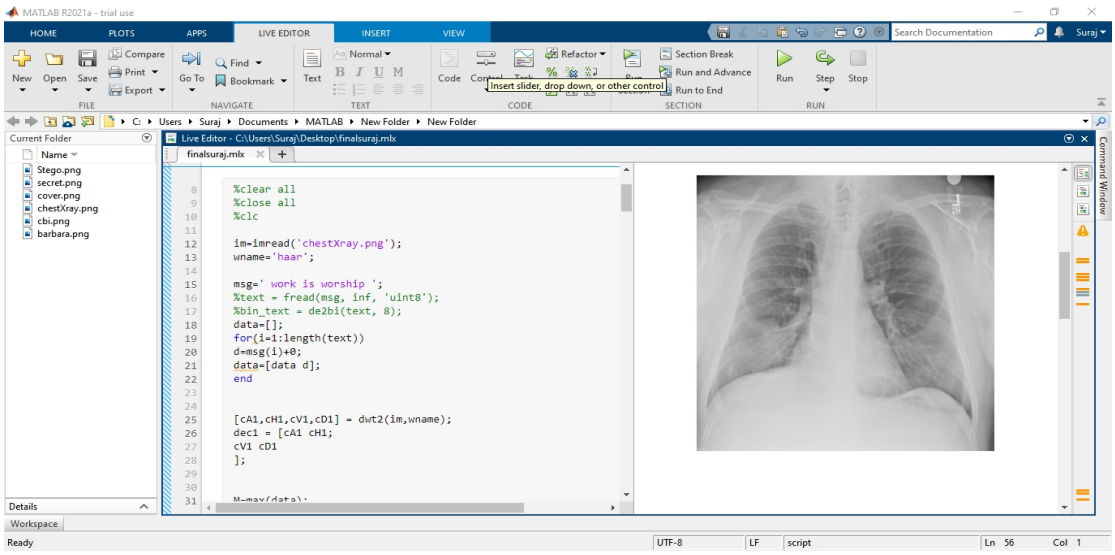
Past your project file path

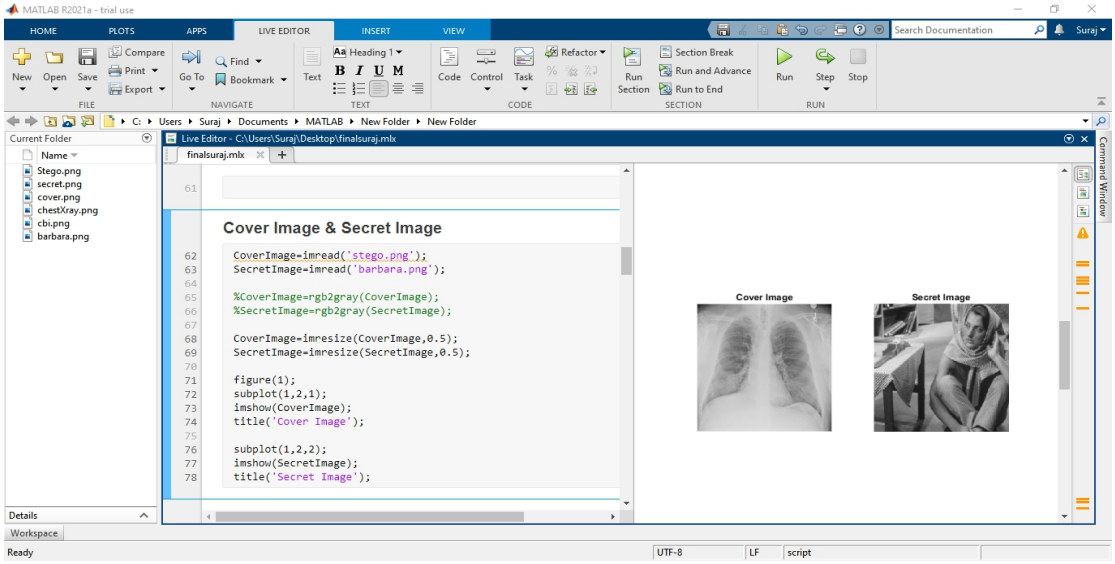


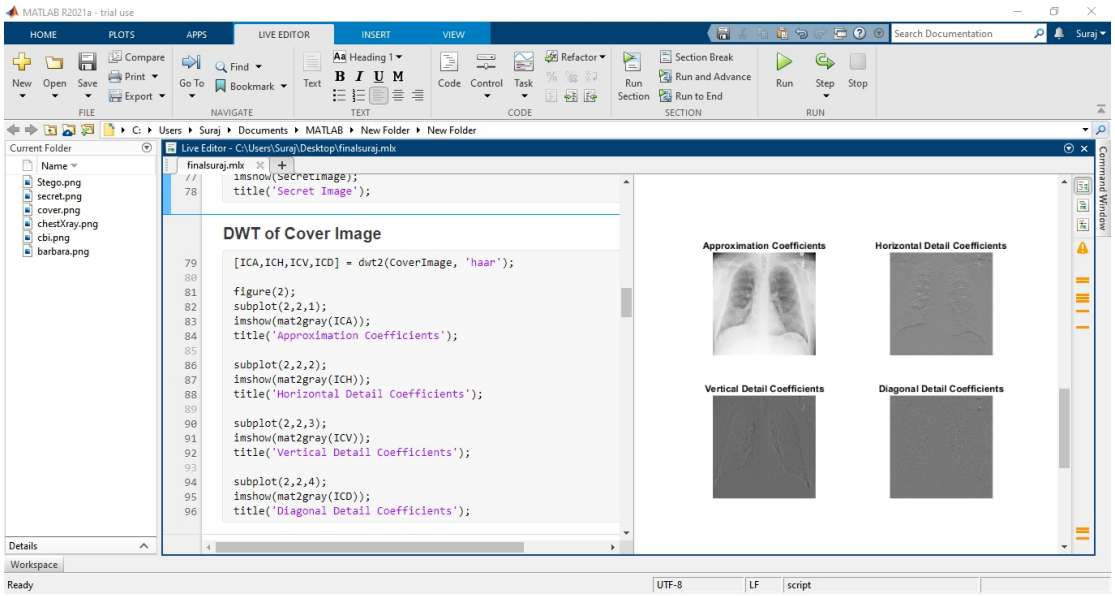
Take a ‘live editor’ from Home tool and open the project code

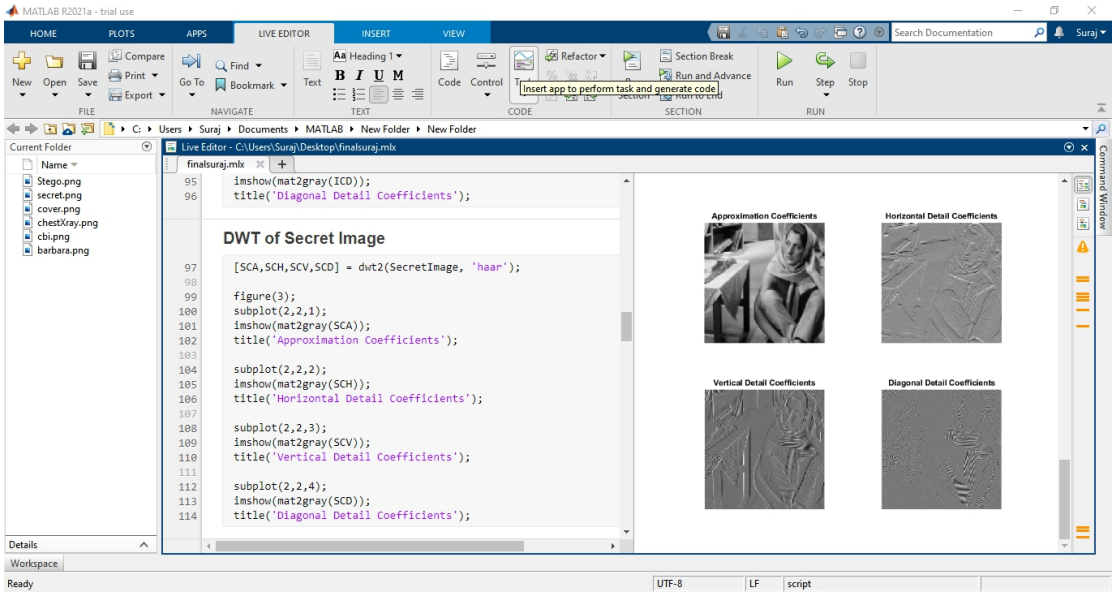


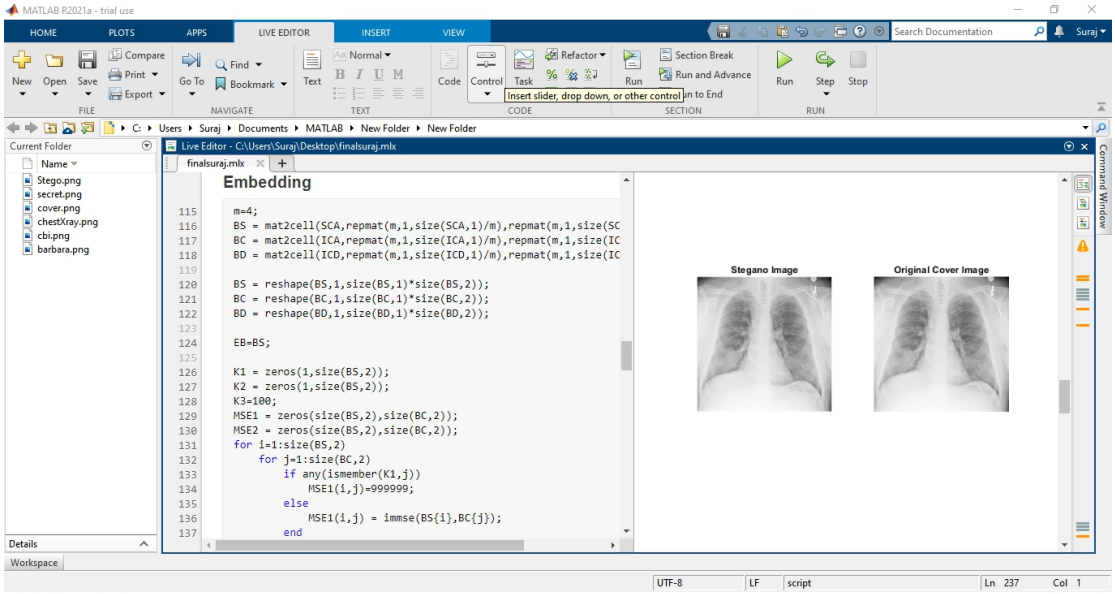
4.STEPWISE SCREENSHOT OF WORKING OF PROJECT

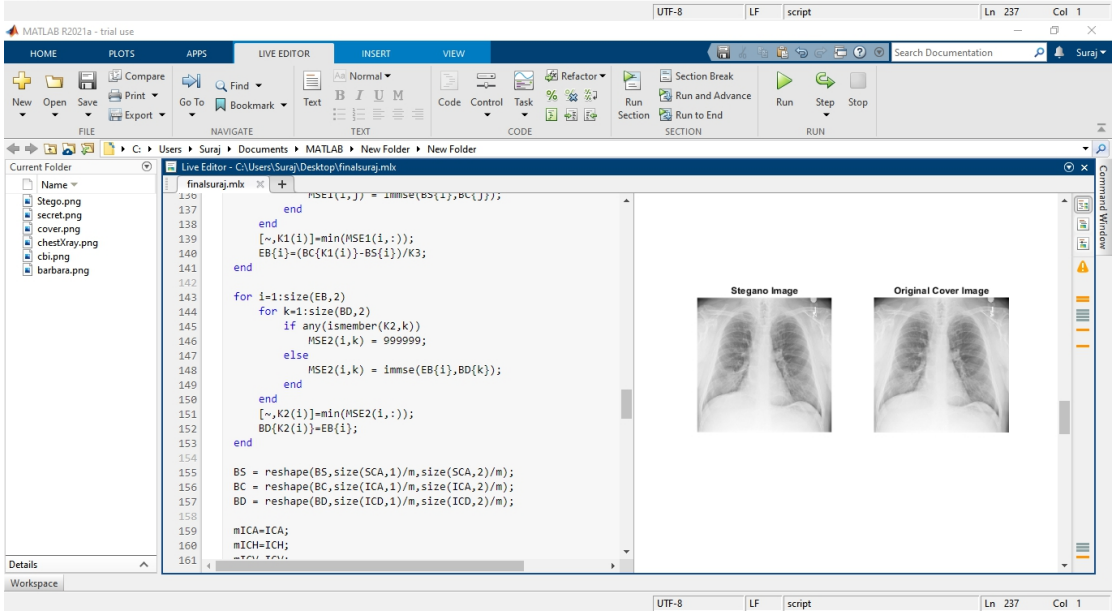




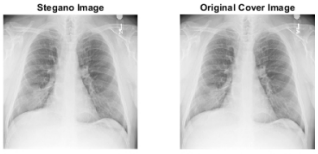



MATLAB R2021a - trial use
Insert app to perform task and generate code
Live Editor - C:\Users\Suraj\Desktop\finalsuraj.mlx
finalsuraj.mlx
imshow(mat2gray(ICD));
title('Diagonal Detail Coefficients');
DWT of Secret Image
[SCA,SCH,SCV,SCD] = dwt2(SecretImage, 'haar');
figure(3);
subplot(2,2,1);
imshow(mat2gray(SCA));
title('Approximation Coefficients');
subplot(2,2,2);
imshow(mat2gray(SCH));
title('Horizontal Detail Coefficients');
subplot(2,2,3);
imshow(mat2gray(SCV));
title('Vertical Detail Coefficients');
subplot(2,2,4);
imshow(mat2gray(SCD));
title('Diagonal Detail Coefficients');
Approximation Coefficients
Horizontal Detail Coefficients
Vertical Detail Coefficients
Diagonal Detail Coefficients
Ready


MATLAB R2021a - trial use
Insert slider, drop down, or other control
Live Editor - C:\Users\Suraj\Desktop\finalsuraj.mlx
finalsuraj.mlx
Embedding
m=4;
BS = mat2cell(SCA,repmat(m,1,size(SCA,1)/m),repmat(m,1,size(SC
BC = mat2cell(ICA,repmat(m,1,size(ICA,1)/m),repmat(m,1,size(IC
BD = mat2cell(ICD,repmat(m,1,size(ICD,1)/m),repmat(m,1,size(IC
BS = reshape(BS,1,size(BS,1)*size(BS,2));
BC = reshape(BC,1,size(BC,1)*size(BC,2));
BD = reshape(BD,1,size(BD,1)*size(BD,2));
EB=BS;
K1 = zeros(1,size(BS,2));
K2 = zeros(1,size(BS,2));
K3=100;
MSE1 = zeros(size(BS,2),size(BC,2));
MSE2 = zeros(size(BS,2),size(BC,2));
for i=1:size(BS,2)
for j=1:size(BC,2)
if any(ismember(K1,j))
MSE1(i,j)=999999;
else
MSE1(i,j) = immse(BS{i},BC{j});
end
Stegano Image
Original Cover Image
Ln 237 Col 1


MATLAB R2021a - trial use
Live Editor - C:\Users\Suraj\Desktop\finalsuraj.mlx
finalsuraj.mlx
end
end
[~,K1(i)]=min(MSE1(i,:));
EB{i}=(BC{K1(i)}-BS{i})/K3;
end
for i=1:size(EB,2)
for k=1:size(BD,2)
if any(ismember(K2,k))
MSE2(i,k) = 999999;
else
MSE2(i,k) = immse(EB{i},BD{k});
end
end
[~,K2(i)]=min(MSE2(i,:));
BD{K2(i)}=EB{i};
end
BS = reshape(BS,size(SCA,1)/m,size(SCA,2)/m);
BC = reshape(BC,size(ICA,1)/m,size(ICA,2)/m);
BD = reshape(BD,size(ICD,1)/m,size(ICD,2)/m);
mICA=ICA;
mICH=ICH;
Stegano Image
Original Cover Image
Ln 237 Col 1

```
[~,K2(i)]=min(MSE2(i,:));
BD{K2(i)}=EB{i};
end

BS = reshape(BS,size(SCA,1)/m,size(SCA,2)/m);
BC = reshape(BC,size(ICA,1)/m,size(ICA,2)/m);
BD = reshape(BD,size(ICD,1)/m,size(ICD,2)/m);

mICA=ICA;
mICH=ICH;
mICV=ICV;
mICD=cell2mat(BD);

SteganoImage=idwt2(mICA,mICH,mICV,mICD,'haar');

figure(4);
subplot(1,2,1);
imshow(mat2gray(SteganoImage));
title('Stegano Image');

subplot(1,2,2);
imshow(mat2gray(idwt2(ICA,ICH,ICV,ICD,'haar')))
title('Original Cover Image');
```



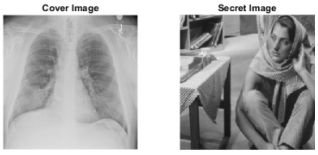

```
subplot(1,2,2);
imshow(mat2gray(idwt2(ICA,ICH,ICV,ICD,'haar')))
title('Original Cover Image');
```

Extraction

```
[GCA,GCH,GCV,GCD] = dwt2(SteganoImage, 'haar');
figure(1);
%subplot(1,2,1);
imwrite(CoverImage,'cbi.png')
imshow(CoverImage);
title('Cover Image');

%subplot(1,2,2);
imshow(SecretImage);
title('Secret Image');
```

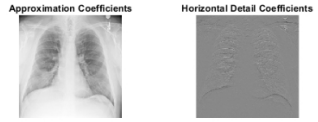
DWT of Cover Image

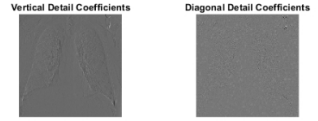
```
[ICA,ICH,ICV,ICD] = dwt2(CoverImage, 'haar');

figure(5);
```



DWT of Cover Image

```
[ICA,ICH,ICV,ICD] = dwt2(CoverImage, 'haar');

figure(5);
subplot(2,2,1);
imshow(mat2gray(GCA));
title('Approximation Coefficients');

subplot(2,2,2);
imshow(mat2gray(GCH));
title('Horizontal Detail Coefficients');

subplot(2,2,3);
imshow(mat2gray(GCV));
title('Vertical Detail Coefficients');

subplot(2,2,4);
imshow(mat2gray(GCD));
title('Diagonal Detail Coefficients');

eBD = mat2cell(GCD,repmat(m,1,size(GCH,1)/m),repmat(m,1,size(G
eBC = mat2cell(GCA,repmat(m,1,size(GCA,1)/m),repmat(m,1,size(G
eBS = cell(1.size(K1.2));
```





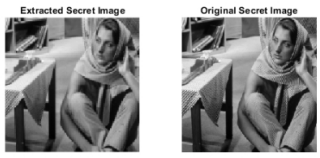
MATLAB R2021a - trial use

HOME | PLOTS | APPS | LIVE EDITOR | INSERT | VIEW

Live Editor - C:\Users\Suraj\Desktop\finalsuraj.mlx

finalsuraj.mlx

```
207  eBC = reshape(eBC,1,size(eBC,1)*size(eBC,2));
208  eBD = reshape(eBD,1,size(eBD,1)*size(eBD,2));
209
210  for i=1:size(K1,2)
211      eBS{i}=eBC{K1(i)}-K3*eBD{K2(i)};
212  end
213
214  eBS = reshape(eBS,size(SCA,1)/m,size(SCA,2)/m);
215
216  eSCA=cell2mat(eBS);
217  eSCH=zeros(size(eSCA));
218  eSCV=zeros(size(eSCA));
219  eSCD=zeros(size(eSCA));
220
221  eSecretImage=idwt2(eSCA,eSCH,eSCV,eSCD,'haar');
222
223  figure(6);
224  subplot(1,2,1);
225  imshow(mat2gray(eSecretImage));
226  title('Extracted Secret Image');
227
228  subplot(1,2,2);
229  imshow(mat2gray(idwt2(SCA,SCH,SCV,SCD,'haar')))
230  title('Original Secret Image');
```



UTF-8 | LF | script | Ln 230 | Col 1

MATLAB R2021a - trial use

HOME | PLOTS | APPS | LIVE EDITOR | INSERT | VIEW

Live Editor - C:\Users\Suraj\Desktop\finalsuraj.mlx

finalsuraj.mlx

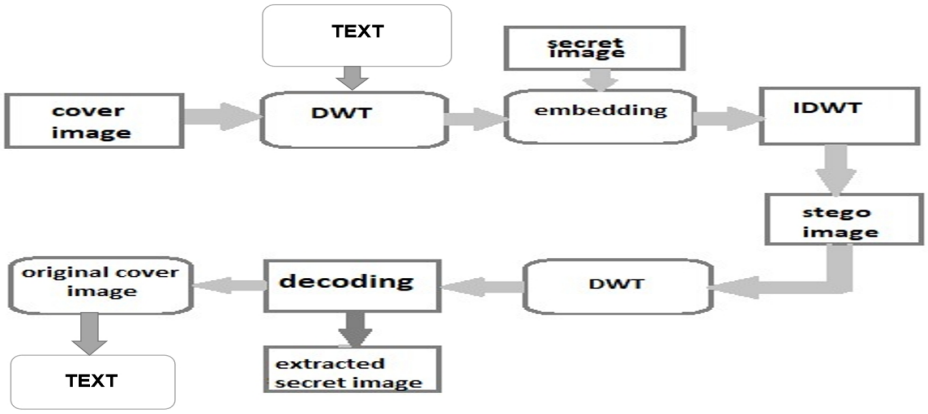
Extraction Of Text from Cover_image

```
233  im=imread('cbi.png');
234  [cA11,cH11,cV11,cD11] =dwt2(CODED1,'haar');
235  data=[]
236  data_norm=[];
237  n=ceil(abs(cH11(1,1)*10));
238  M=ceil(abs(cH11(1,2)*10));
239
240  for(i=1:1:ceil(n/2))
241  data_norm(i)=cV11(i,y);
242  end
243
244  for(i=ceil(n/2)+1:1:n)
245  data_norm(i)=cD11(i,y);
246  end
247  data=ceil(data_norm*M)-1;
248  msg1='';
249  for(i=1:length(data))
250  msg1=strcat(msg,data(i));
251  end
252
253  msg1
```

```
data =

     []

msg1 = ' work is worship'
```

UTF-8 | LF | script

5.Block diagram:



6.Algorithm: for embedding

1.With the Discrete Wavelet Transform, convert -

the cover image, I, into the 4 subimages: (ICA, ICH, ICV, ICD) and

the secret image, S, into the 4 subimages: (SCA, SCH, SCV, SCD)

2Each of SCA, ICA and ICD are partitioned into 4x4 pixels -

SCA = {BSi , 1<=i<=ns}

ICA = {BCj , 1<=j<=nc}

ICD = {BDk , 1<=k<=nc}

where BSi , BCj and BDk represent the ith block in SCA, jth block in ICA, kth block in ICD respectively, ns is the total number of 4× 4 blocks in SCA and nc is the total number of the 4× 4 blocks in each of ICA and ICH.

3.For each block BSi in SCA, the best matched block BCj of minimum error in ICA is searched by using the root mean squared error (RMSE).

The first secret key K1 consisting of the addresses, j, of the best matched blocks in ICA.

4.Calculate the error block EBi between BSi and BCj as follows:

EBi = (BCj - BSi) / K3

Where K3 is a secret key chosen randomly between 100 and 170.

5.For each error block EBi , the best matched block BDk in ICD is searched for using the RMSE criteria as before, and that BDk is replaced with the error block EBi .

The second secret key K2 consists of the addresses, k of the best matched blocks in ICD.

6.until all the produced error blocks are embedded in ICD.

7.Apply the inverse DWT to the sub-images - ICA, ICV, ICH and the modified ICD to obtain the stegano image.

Algorithm: for extraction

1.With the Discrete Wavelet Transform, convert the stegano image, G, into the 4 subimages: (GCA, GCH, GCV, GCD).

2.The extracted secret image coefficients, eBSi , are obtained by -

eBSi = eBCK1(i) - K3 * eBDK2(i)

where

{ eBCj } = GCA

{ eBDk } = GCD

3.Repeat Step 2 until all secret blocks are extracted and form the subimage, eSCA, as follows:

eSCA = { eBSi }

4.Assign each of eSCD, eSCV and eSCH as zeros and apply the inverse DWT to obtain the retrieved Secret Image.

7.Code output:

1. Output of embedding of an text into cover image:

ms = 7.8201e-06
ps = 99.1987

2.images are going to use for the code ‘cover image’,’ secret image’ respectively

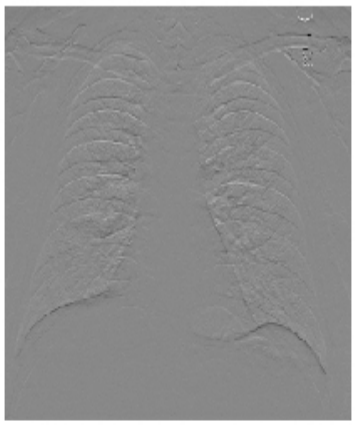
Cover Image

Secret Image

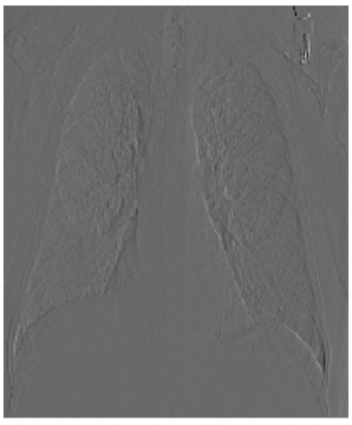
3.DWT of cover image

Approximation Coefficients

Horizontal Detail Coefficients

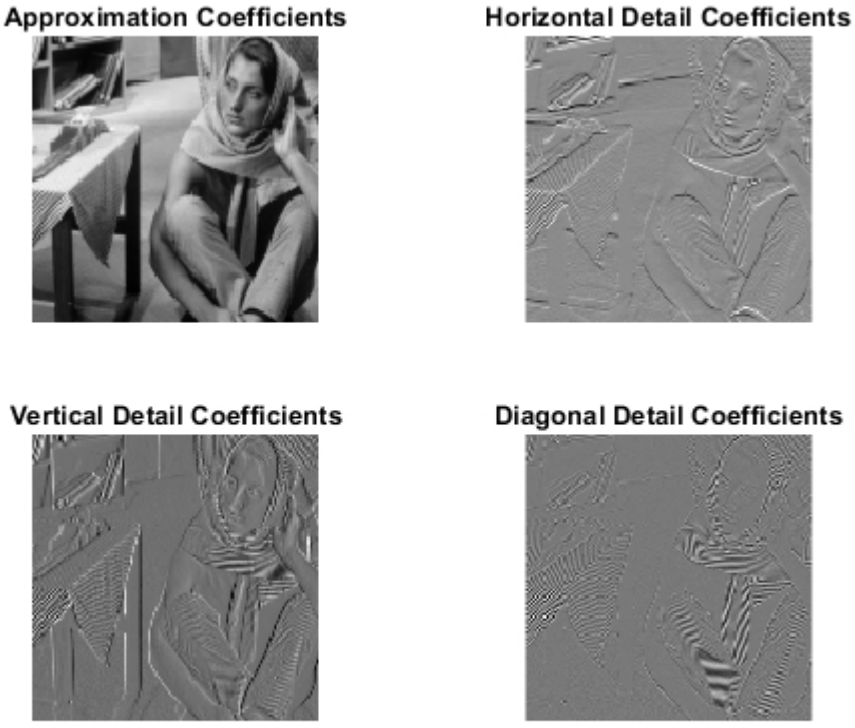


Vertical Detail Coefficients



Diagonal Detail Coefficients

4.DWT of secret image



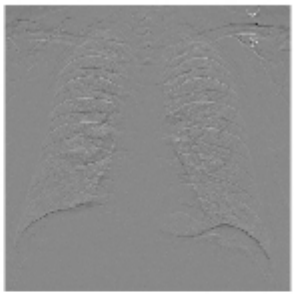
5.embedding process is done , and comparisen between embedded image(stegano image) & original cover image

6.Extraction process is completed.

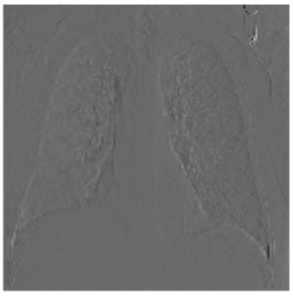
7.After extraction effect on cover image

Approximation Coefficients

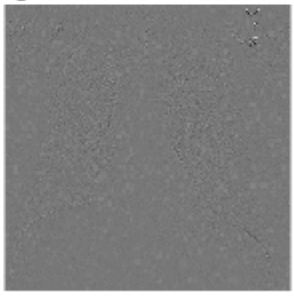
Horizontal Detail Coefficients



Vertical Detail Coefficients



Diagonal Detail Coefficients



Extracted Secret Image

Original Secret Image

8. extraction of TEXT from Cover_Image

```
data =

     []
msg1 = ' work is worship'
```

8.Conclusion:

- in our project multi-steganography is possible.

- At 1st text is get embedd into an cover image and after the secret image is get embedded into cover image
- After at extraction stage the secret image is extracted sucesfully from cover image.
- Then secret text is also extracted sucessfully from cover image
- Due to multi_steganography , the secret_text or secret_image can be used as false data and true data respectively or vice-versa. For security purpose.

9. code links:

https://github.com/mohdshahbaz123/Image-Steganography